6. MANAGEMENT AND MONITORING

Management and monitoring strategies for the restored eastern population are based on limited knowledge gained through the first five years restoration efforts. The impact of drastic changes in both the landscape and human population in the hundred years or so since whooping cranes were recorded in Wisconsin, along with unknown variables concerning environmental protection and reproduction issues, will require adaptive management and monitoring strategies as new information is gathered and assessed.

6.1 GOAL

The goal of this management plan is to protect the reintroduced whooping cranes and their habitat, thus helping the North American population reach ecologic and genetic stability, while also considering the needs and interests of state citizens and communities. The project's long-term goal is whooping crane recovery and eventual removal (delisting) from the Federal List of Threatened and Endangered Species (CWS & USFWS, 2006). However, present gaps in our knowledge of this species prevents establishment of delisting objectives and criteria. An interim goal for 2020 is the restoration of a self-sustaining EMP with a minimum but growing population of 100-120 birds encompassing 25-30 breeding pairs that regularly nest and fledge offspring.

6.2 POPULATION MANAGEMENT

It is essential to continue to monitor and document the EMP in terms of population size, genetic diversity, habitat use, breeding activity, social interactions, potential hazards, mortality, and movements while in Wisconsin. In addition to the obvious need for population trends over time, it is important to collect estimates of survival and recruitment (and their separate components) which can be used to model population dynamics. Although the EMP is genetically derived from the AWBP, its population dynamics will probably differ due to their dissimilar environments at both ends of their migration routes. Management of the EMP is best based on locally-driven estimates of their population dynamics, rather than using AWBP estimates (refer to Population Dynamics, Section 5.8).

6.3 GENETIC DIVERSITY

The North American whooping crane population is derived from an estimated six to eight founders, with a loss of 66 percent of all genetic material (Mirande, Lacy & Seal, 1993; Glenn, Stephen, & Braun, 1999). Genetic analyses suggest genetic diversity losses in mitochondrial DNA, nuclear DNA, and blood proteins (Jones & Lacey, 2006).

The captive breeding population, derived from the AWBP, has inherited this legacy of genetic loss. Since the eastern population originated from the captive population, this high level of diversity loss has serious implications for whooping crane population management. Genetic changes within the population through inbreeding threaten to reduce productivity before the population is large enough for mutation to offset losses in diversity from genetic drift (Frankel & Soule, 1981; Ballou, Gilpin, & Foose, 1995). Based on the EMP pedigree, the demographic and genetic analysis presented below was completed by Ken Jones to guide future management recommendations and strategies. (A full description and analysis of the genealogy of all North American whooping cranes is contained in the *Whooping Crane Master Plan for 2006* by Ken Jones, as prepared and revised annually for the International Whooping Crane Recovery Team.)

6.3.1 Eastern Population Demographics
As of January 1, 2006, the EMP contained 64 birds. The population is growing at an average rate of 12.8 birds per year. It is expected to reach 100-120 birds by 2011 (Fig. 6) Of the 64 birds, there is a slight skew towards males (36 males and 28 females). The large gender discrepancy in 2003 and 2004 released birds was an attempt to correct a similar sex imbalance in the captive bird population (Fig. 7). A complete genealogy of the first 64 EMP whooping cranes is presented in Appendix 3.

So far the results are encouraging. The EMP has better survivorship than the non-migratory Florida population. If this trend continues, the life expectancy of EMP birds should be significantly longer than Florida birds (Fig. 8).

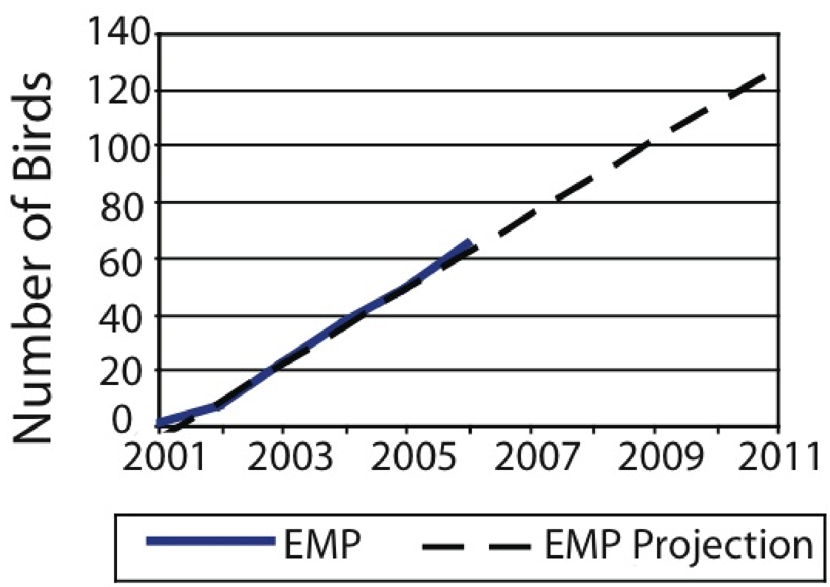

Figure 6. Current and projected EMP growth.

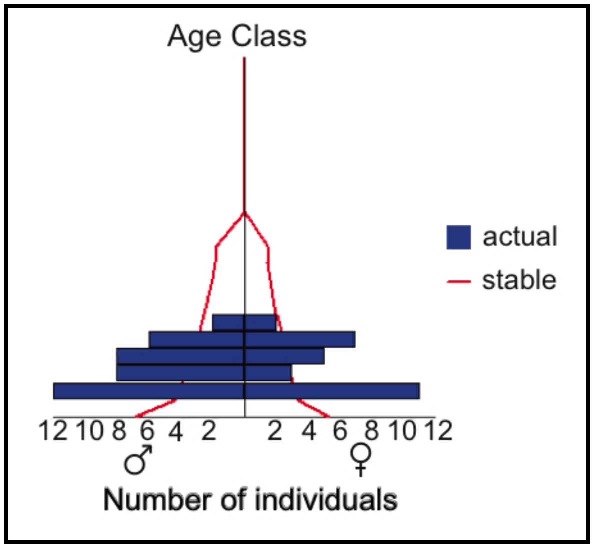

Figure 7. EMP age and sex distribution, January 1, 2006.

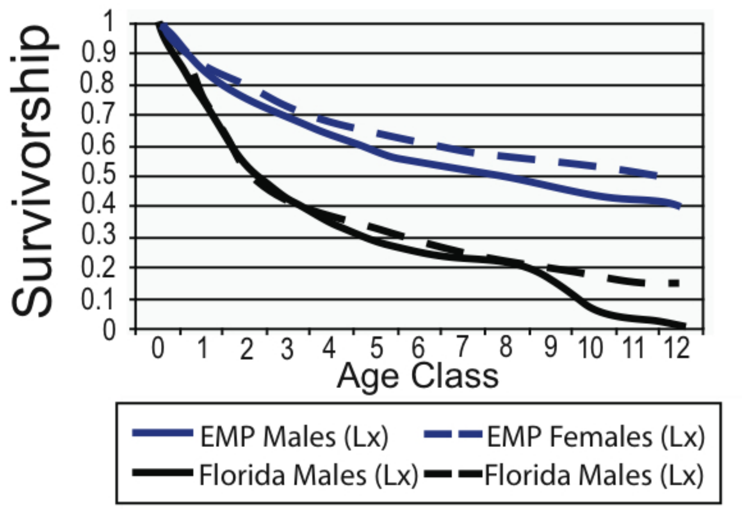

Figure 8. EMP survivorship exceeds the FP survivorship.

6.3.2 Eastern Population Genetics

Analysis of the January 2006 population indicates 52 percent of the population stems from two half-sibling females, numbers 1135 and 1136 (Fig. 9, Table 1). The total population of 64 birds derives from 12 remaining female lines and 13 male lines. One male (1133) has contributed 25 percent of the total offspring as a mate to 1135 (Fig. 10, Table 1). Additionally, a large percentage of released birds descend from two grandparents, 1019 is a grandfather to 29 (45 percent) and 1027 is grandmother to 42 (66 percent) of the population (Appendix 3). Since a disproportionately high number of offspring come from the genetic heritage of 1135 and 1136, under an assumption of random mating, a high rate of sibling mating could occur. As of June 2006, out of seven pairs formed in the EMP, two have been sibling pairs.

Table 1. Sires and Dams of 64 EMP birds (2001-2005).

Sires				**Dams**			
Rank	SB No.	No. of offspring	percent of total	Rank	SB No.	No. of offspring	percent of total
1	1133	16	25.0	1	1135	21	32.8
2	1144	12	18.8	2	1136	12	18.8
3	1127	6	9.4	3	1154	6	9.4
5	1128	5	7.8	4	1142	5	7.8
5	1147	5	7.8	5	1119	4	6.3
5	1560	5	7.8	9	1098	2	3.1
7	1114	4	6.2	9	1140	2	3.1
10	1130	2	3.1	9	1167	2	3.1
10	1162	2	3.1	9	1188	2	3.1
10	1175	2	3.1	9	1195	2	3.1
10	1182	2	3.1	9	1263	2	3.1
10	1189	2	3.1	9	1292	2	3.1
13	1041	1	1.6	13.5	1101	1	1.6
				13.5	1197	1	1.6

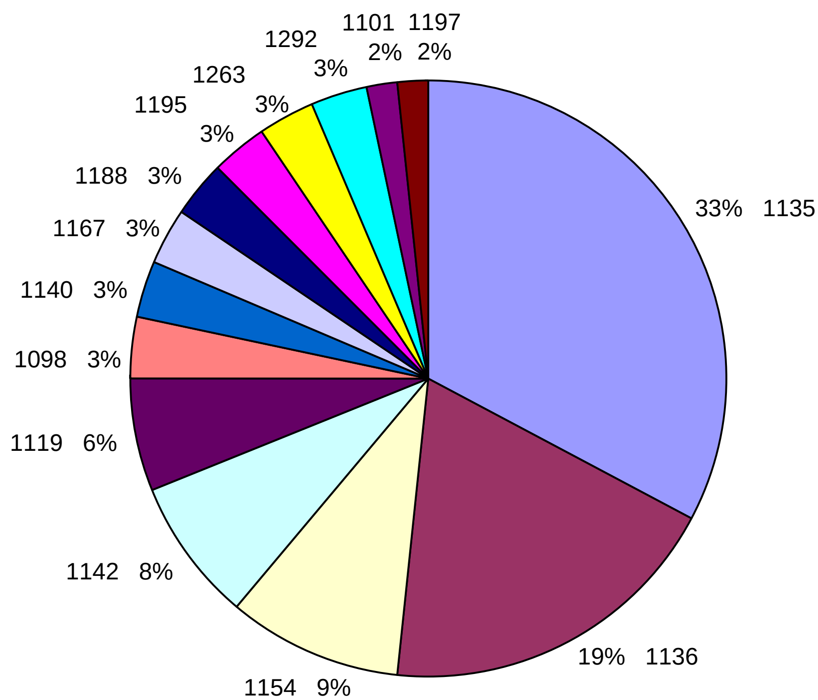

Figure 9. EMP female ancestry.

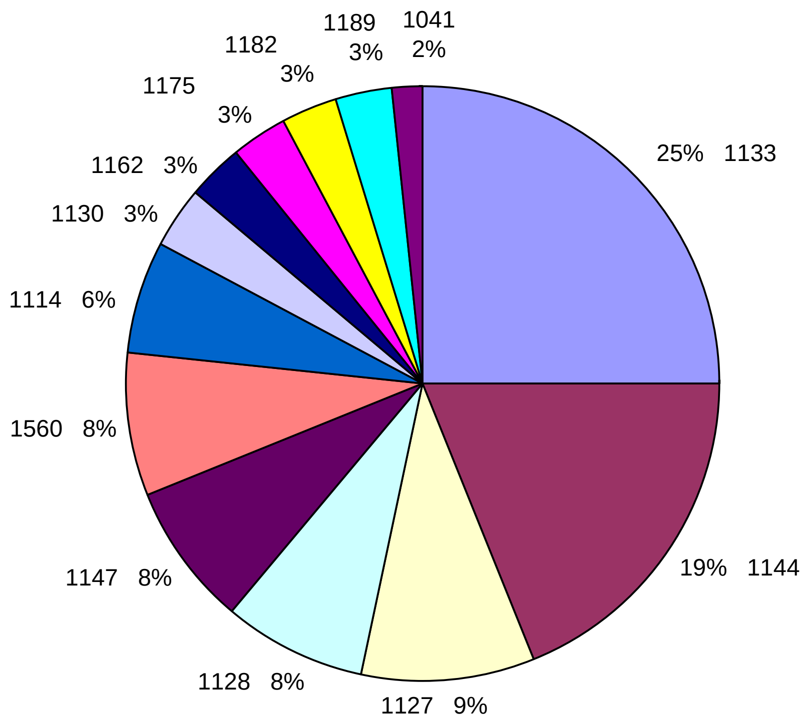

Figure 10. EMP male ancestry.

6.3.3 Population Recommendations

Since the population is demographically stable, attention should focus on its long term genetic health. High levels of inbreeding, such as full sibling mating, produce a decline in hatchability and juvenile fitness in many bird species. Low allelic diversity may also result in increased vulnerability to disease mortality (Jones & Lacey, 2006). Currently, the reintroduction program is faced with inbreeding likely to result from reproduction by paired siblings in the earliest cohorts (2001-2003). It is doubtful these birds will immediately dissolve their pair bonds in favor of less-related mates. In a 14 year study of sandhill cranes, the mean pair bond lasted 5.7 years, severed through either permanent divorce or death of a mate (Hayes & Barzen, 2003). In the long term, genetically poor pairings may be corrected with mate switches by the release of less closely related birds. Meanwhile, several management strategies can help increase genetic diversity in this population.

First, to maintain a healthy female population, future release cohorts should contain an equal representation of males and females.

Second, to improve the EMP's genetic health, the genetics of the EMP and captive population should be analyzed yearly. The resulting analysis should guide annual chick allocation as described below:

- Chicks genetically valuable to both populations should be allocated equally between the captive and migratory eastern population.
- Chicks that will bolster EMP genetic diversity but reduce diversity in the captive population should be allocated to the EMP release program.

- Chicks that would significantly decrease the EMP's genetic diversity should not be released. Specifically, chicks from female 1135 should not be released as she currently has 21 surviving offspring in the release population. Further, chicks from 1136 should only be released if sufficient numbers of chicks are unavailable from more genetically suitable pairs. Suspending the release of offspring from over-represented females (i.e., 1135 and 1136) and preferentially releasing offspring of under-represented females will increase the gene diversity of the population, and ultimately reduce overall inbreeding.

Third, reproduction by sibling pairs should be discouraged until the population grows sufficiently large to assure a low incidence of these pairings. Possible methods include:

- Letting the sibling pair continue first-time nesting. This option will provide an opportunity for the birds to demonstrate successful parenting, thus becoming candidates for future surrogate parenting of non-sibling swapped eggs.
- Swapping eggs from a sibling pair with those of an out-bred pair. The genetically suitable eggs could come from captive birds, as a first choice, or from other EMP nesting pairs. This strategy alleviates the problem in the short term, but takes considerable monitoring to assure that no eggs from the pair hatch prior to swapping. However, removing the eggs selects against the genetic heritage of that family line.
- Removing the male of the pair from the population. This strategy would permanently solve the inbreeding problem caused by that pair. By removing one of the two birds, the genes from that family line would enter the population when each sibling eventually paired with an unrelated bird. Because full sibling mating is more likely when a family line is over-represented, removal of the male would also help equalize family representation within the population.